EXECUTIVE SUMMARY

ENERGY ENGINEERING ANALYSIS PROGRAM

FOR

NAHA PORT AND TORII STATION

OKINAWA, JAPAN

PREPARED FOR:

DEPARTMENT OF THE ARMY
Pacific Ocean Division
Corps of Engineers

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CHAPTER 1
INTRODUCTION

1.1 Objective

The objective of the Energy Engineering Analysis (EEA) Program is to develop an energy system plan that will reduce basewide energy consumption. A number of potential energy conservation opportunities (ECO) have been reviewed for technical and economic feasibility. Those ECO which have been determined to be feasible are presented in this report as recommended Energy Conservation Investment Program (ECIP) projects or recommended Operational & Maintenance (O&M) projects. These projects are the core of the coordinated basewide energy system plan.

1.2 Energy Goals

Presidential Executive Order 12003 was signed by the President on July 20, 1977. The Executive Order requires all Federal Agencies to develop a 10-year plan for energy conservation in government buildings.

The National Energy Act was passed on October 15, 1978 and is composed of five bills. One of these bills is the National Energy Conservation Policy Act. One of the provisions of the Act is the conservation requirement for Federal Buildings, including a comprehensive plan to reduce energy use and to initiate an energy audit program.

The Army Facilities Energy Plan was published on October 15, 1980 and established long and short-range goals and policies that are consistent with Executive Order 12003, the National Energy Conservation Policy Act, and the Defense Energy Program Policy Memorandum.

The short-range goal of the Army is to achieve a reduction of 20 percent in existing buildings, 45 percent in new buildings and overall 25 percent on the average energy use per gross square foot of floor space by the year 1985 from that used in the base year of 1975. The long-range goal is to reduce the facility energy consumption by 50 percent by the year 2000 based on the year 1975.

CHAPTER 2
SUMMARY AND RECOMMENDATIONS

The ECO that are recommended for implementation at Naha Port and Torii Station are summarized in Table 2-1. Two of the ECO that are listed do not meet the ECIP criteria for funding; however, these ECO are included because of the associated potential for significant energy savings.

Because electricity accounts for 91 percent of the source energy used at Naha Port/Torii Station, attention was focused on ECO that reduce electricity consumption. The major end uses of electricity include lighting, domestic water heating and air conditioning. The approach was to locate areas and determine times of unnecessary use and to find solutions that would eliminate such waste.

Time Clock Controls (ECO M1) is recommended as a FY 85 ECIP project. Shower Flow Restrictors, Heat Pumps and Heat Recovery Systems (ECO M2, M4 and M5), Reflective Film (ECO A3), and Higher Efficiency Lamps (ECO E1) are recommended as FY 83 O&M projects.

TABLE 2-1

PROJECT SUMMARY

Project Number*	Project Description	CWE ($1,000)	Annual Savings (MBTU)	E/C	B/C	Pay Back Years
(ECO M1) FY 85	Time Clock , Controls	122.5	10,572	86.32	14.66	0.76
(ECO M2, M4, M5) FY 83	Shower Flow Restrictors, Heat Pumps, Heat Recovery Systems	65.4	3,667	56.11	11.62	1.22
(ECO A3) FY 83	Reflective Film	70.3	1,147	16.30	1.67	5.80
(ECO E1) FY 83	Higher Efficiency Lamps	128.3	1,474	11.50	1.18	8.22
(ECO M3) FY 84	Boiler Stack Dampers	46.4	818	17.62	4.46	3.22

*Includes the ECO number and the fiscal year for which the analysis was prepared. The indicated fiscal year relates to the estimated midpoint of construction.

CHAPTER 3
CURRENT ENERGY CONSUMPTION

The FY 80 monthly energy consumption for both Naha Port and Torii Station is shown in Table 3-1. The information was obtained from the records of the Facility Engineer. Information relating to energy consumption prior to FY 80 was not available.

During FY 80, total basewide energy consumption amounted to 172,581 MBTU. Of that total, 152,676 MBTU was used at Torii Station, while the remaining 19,905 MBTU was used at Naha Port. In terms of the source energy used, electricity accounted for 137,058 MBTU (79.4 percent) and 19,428 MBTU (11.3 percent); while fuel oil accounted for 15,618 MBTU (9.0 percent) and 477 MBTU (0.3 percent), respectively, at Torii Station and Naha Port.

TABLE 3-1

ENERGY CONSUMPTION, NAHA PORT/TORII STATION

	NAHA PORT				TORII STATION				
	Electricity		Fuel Oil	Total	Electricity		Fuel Oil	Total	Grand Total
Month	KWH	MBTU	MBTU	MBTU	KWH	MBTU	MBTU	MBTU	MBTU
Oct 79	147,400	1,710	-	1,710	1,049,200	12,171	480	12,651	14,361
Nov 79	121,200	1,406	-	1,406	792,300	9,19[illegible]	1,481	10,672	12,078
Dec 79	106,184	1,232	55	1,287	657,200	7,624	1,588	9,212	10,499
Jan 80	148,128	1,718	34	1,752	840,500	9,750	2,589	12,339	14,091
Feb 80	129,648	1,504	274	1,778	710,600	8,243	1,774	10,017	11,795
Mar 80	125,568	1,457	72	1,529	780,800	9,057	2,807	11,864	13,393
Apr 80	130,488	1,514	42	1,556	752,000	8,723	1,069	9,792	11,348
May 80	146,076	1,694	-	1,694	954,600	11,073	912	11,985	13,679
Jun 80	147,768	1,714	-	1,714	1,340,150	15,546	1,000	16,546	18,260
Jul 80	162,096	1,880	-	1,880	1,397,200	16,208	645	16,[illegible]	18,733
Aug 80	152,796	1,772	-	1,772	1,240,900	14,394	571	14,965	16,737
Sep 80	157,464	1,827	-	1,827	1,299,800	15,078	702	15,780	17,607
TOTAL FY 80	1,674,816	19,428	477	19,905	11,815,250	137,058	15,618	152,676	172,581

CHAPTER 4
METHODOLOGY

4.1 General

The approach adopted for this program was the MODEL BUILDING CONCEPT. The idea of the concept was to audit only selected (model) buildings which were representative of a larger group of similar buildings. The similar buildings were classified with regard to function, occupancy, energy consumption pattern and architectural construction. Results from the detailed model building audit and analysis were then extrapolated to provide energy end-use information for the entire group of similar buildings.

4.2 Field Investigation

The field investigation was conducted (1) to establish the baseline energy consumption level; (2) to determine the condition of the bases' energy production, distribution and end-use systems; and (3) to identify model buildings' energy conservation opportunities.

4.3 Preliminary Analysis

All potential ECO were examined for technical and economic feasibility. The minimum economic criteria specified for ECIP projects were:

$$S/C \geq 1 \text{ and}$$

$$E/C \geq 17$$

where S/C is the ratio of the life cycle benefits to life cycle costs and E/C is the ratio of annual energy savings (measured in MBTU) to Current Working Estimate (CWE) cost, measured in thousand dollars.

4.4 ECIP Analysis

All ECO which met the minimum criteria specified above were then more carefully analyzed. The detailed analyses were facilitated by the use of a computerized ECIP analysis program. A summary of the results of the ECIP analyses has already been presented in Chapter 2. Several important aspects of the analyses will now be discussed.

4.4.1 Escalation Rates

The construction escalation factors used were based on an annual escalation rate of 9 percent. Construction prices effective on July 1, 1981 have an escalation factor of 1.00. The annual escalation rate used for the cost of electricity was 13 percent; while the annual escalation rate used for the cost of fuel oil was 19 percent. The base year for energy costs was FY 80.

4.4.2 ECO Energy Savings

Calculations of energy savings were performed by using the Model Building Concept. The energy savings for an entire group of similar buildings were extrapolated from energy savings of selected model buildings. The energy savings for the model buildings, in turn, were determined from analyses of on-site energy audits. The source energy equivalents of electricity and diesel fuel oil were specified as 11,600 BTU per kwh and 138,700 BTU per gallon, respectively.

4.4.3 Project Costs

The initial costs of ECO projects are the nonrecurring initial capital costs of the potential ECO projects and include construction, supervision, inspection, and overhead, which together comprise the Current Working Estimate (CWE). Also included are the design costs and other initial, one-time only costs such as the negative cost for the residual value of existing equipment removed during construction.

4.4.4 Economic Life

An economic life of 15 years was used in the analysis of all projects.

CHAPTER 5
BASEWIDE ENERGY ANALYSIS

5.1 Energy Consumption

During FY 80, energy consumption amounted to a total of 172,581 MBTU. Of this total, 156,486 MBTU (91 percent) was in the form of electricity; while the remaining 16,095 MBTU (9 percent) was in the form of fuel oil. Records of individual building energy consumption were not available. Therefore, calculations were performed to determine energy use according to building type and end use.

The calculated energy consumption was 151,218 MBTU or approximately 88 percent of the actual facility energy consumption. It is assumed that the remaining 12 percent (21,363 MBTU) were used in buildings not covered by the scope of this program.

5.2 End-Use Analysis

The calculated energy consumption is tabulated according to building type and end use in Table 5-1. Figures 5-1 and 5-2 indicate the energy consumption levels of the various building types and end uses, respectively.

Troop Housing accounts for 50 percent of the total calculated consumption. In terms of end use, lighting and domestic water heating account for 31 percent and 30 percent, respectively, of the total calculated consumption.

Figure 5-3 illustrates the per square foot energy consumption level for the various model buildings. The Post Office/Dental Clinic and the NCO Open Mess/Club exhibit the highest consumption levels.

5.3 Future Projection of Basewide Energy Consumption

Table 5-2 indicates the projected FY 85 basewide energy consumption for Naha Port/Torii Station, assuming that all recommended projects will have been implemented. The recommended projects have the potential for reducing total annual consumption by 16,860 MBTU corresponding to a reduction of 0.0260 MBTU/sq. ft./yr. These reduction levels represent a 10 percent decrease from the FY 80 level. The FY 85 consumption level is projected to be approximately 156,000 MBTU or 0.2399 MBTU/sq. ft.

TABLE 5-1

BASEWIDE ENERGY BY END USE AND BUILDING TYPE
NAHA PORT/TORII STATION

Building Type		Heating MBTU	A/C MBTU	Lighting MBTU	D.H.W. MBTU	Other MBTU	Total MBTU	Percent (%)
I	Admin	1,799	1,091	6,933	1,807	1,155	12,785	8.4
II	Medical	55	199	680	1,489	408	2,831	1.9
III	None	--	--	--	--	--	--	--
IV	Service	1,853	5,268	8,950	1,709	4,198	21,878	14.5
V	None	--	--	--	--	--	--	--
VI	Troop Housing	3,757	14,849	13,354	37,728	6,605	76,293	50.5
VII	Storage	26	5,712	12,291	353	1,639	20,021	13.2
VIII	Industrial	2,378	5,024	5,273	2,977	1,758	17,410	11.5
IX	None	--	--	--	--	--	--	--
X	None	--	--	--	--	--	--	--
	TOTAL	9,868	32,143	47,381	46,063	15,763	151,218	100.0
	%	6.5	21.3	31.3	30.5	10.4	100.0	

Actual Basewide Energy Consumption for FY 80 = 172,581 MBTU

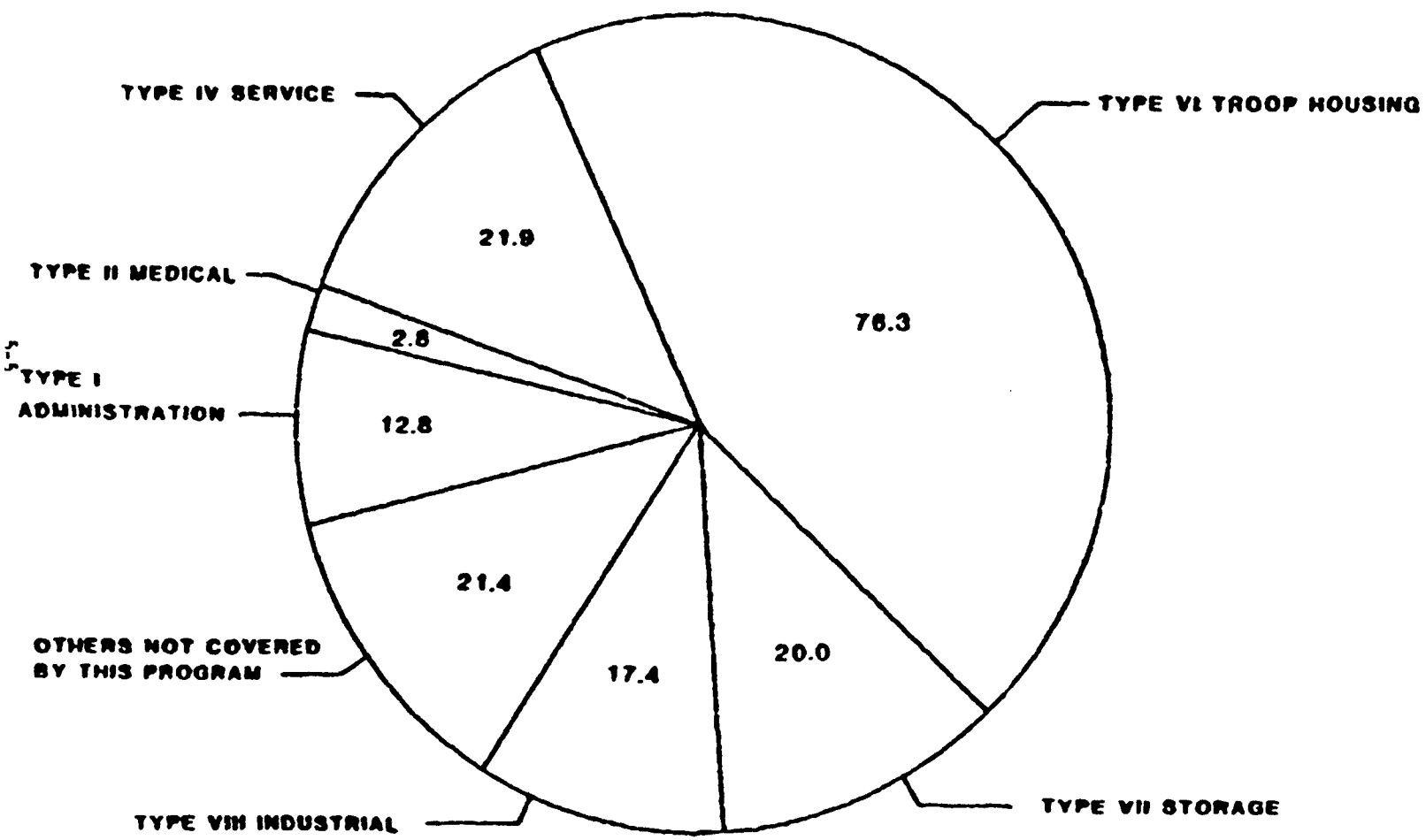
TABLE 5-2

FUTURE PROJECTION OF BASEWIDE ENERGY CONSUMPTION

Year	Electricity MBTU	Fuel Oil MBTU	Total MBTU	Total Sq. Ft.	Unit Energy Use MBTU/Sq. Ft.
FY 80	156,486	16,095	172,581	649,032	0.2659
ECIP Savings	8,159	2,413	10,572	649,032	-0.0163
O&M Savings	2,812	3,476	6,288	649,032	-0.0097
FY 85	145,515	10,206	155,721	649,032	0.2399

FIGURE 5-1

ENERGY USE BY BUILDING TYPE, NAHA PORT/TORII STATION

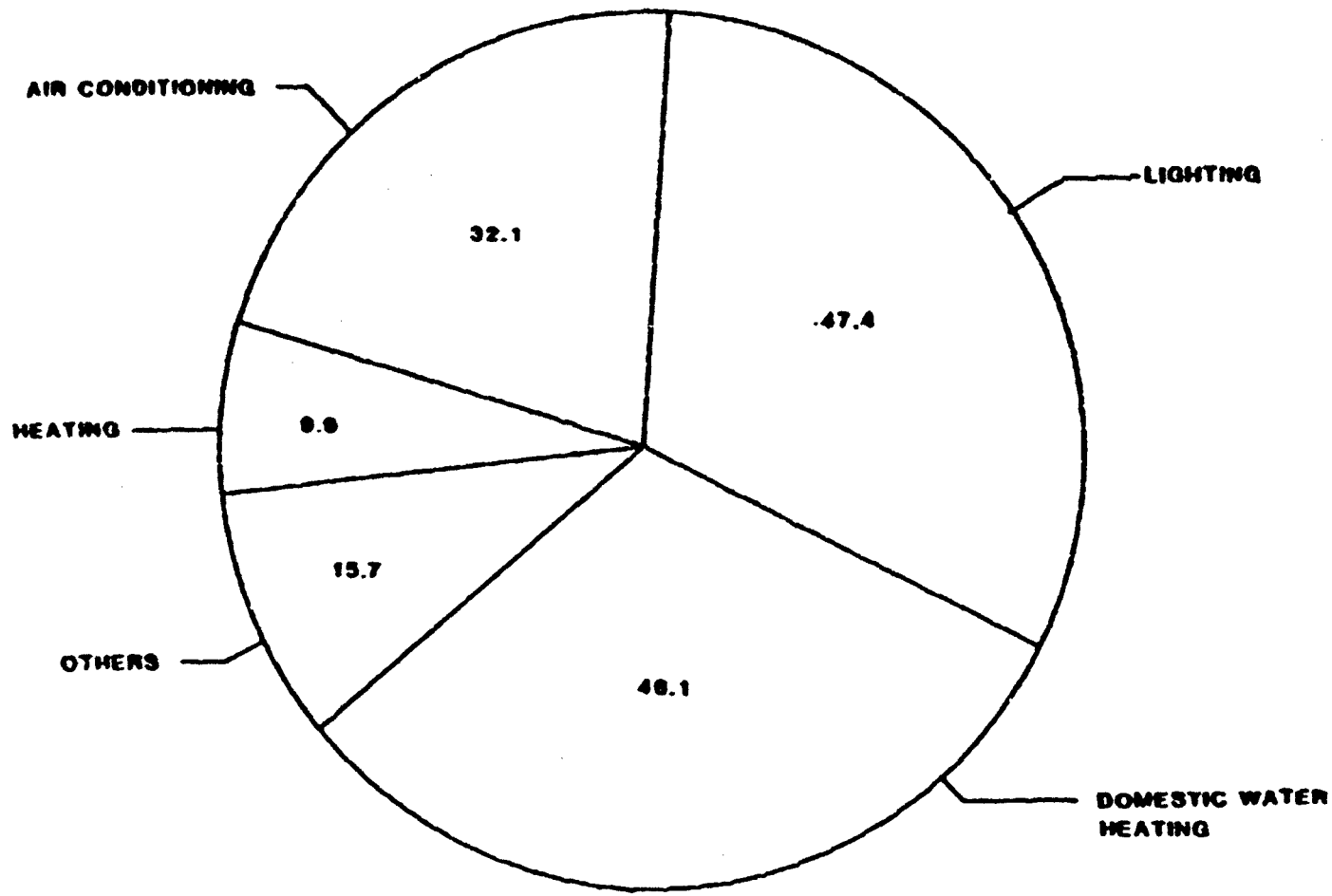


TOTAL CONSUMPTION : 172.6 X 10^9 BTU

BTU X 10^9

FIGURE 5-2

BASEWIDE ENERGY END-USE, NAHA PORT/TORII STATION

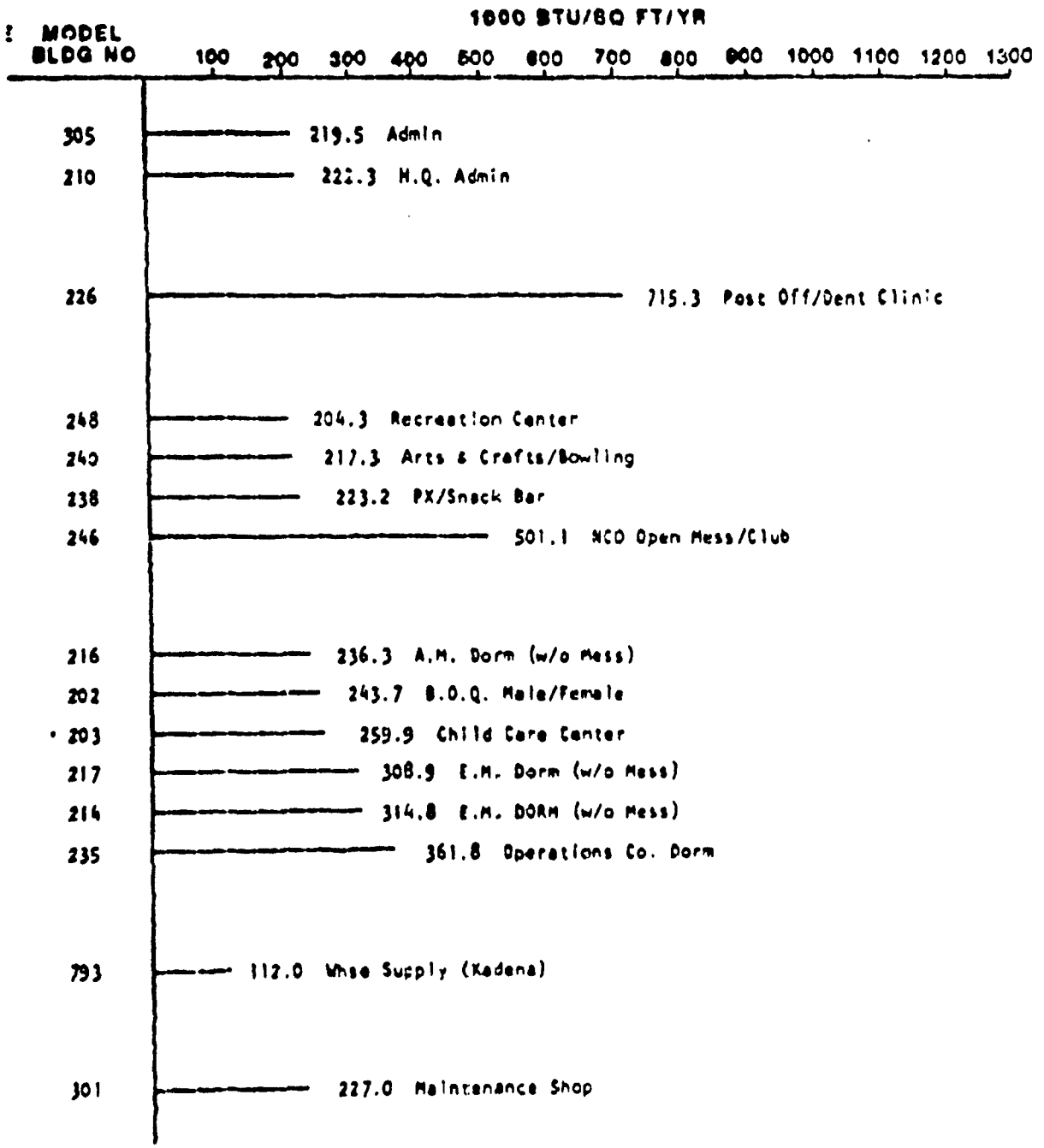


TOTAL CONSUMPTION : 151.2 X 10^9 BTU

BTU X 10^9

FIGURE 5-3

TOTAL ENERGY CONSUMPTION OF MODEL BUILDINGS, NAHA PORT/TORII STATION



DEPARTMENT OF THE ARMY

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